REMARKS

This Reply is being filed in response to the Office Action dated July 8, 2005. This Reply is timely filed. Claims 1-11 are pending in the application. Claim 1-4 and 6 have been rejected under 35 USC §102(b). Claims 1, 5 and 7-11 have been rejected under 35 USC §103(a). The claim rejections are set out in more detail below.

In response to the Examiner's rejections, claims 1, 4 and 6 have now been amended. Claims 3, 5, 7 and 8 have now been canceled. New claims 35-37 have now been added.

I. Brief Review of Applicants' Invention

Prior to addressing the Examiner's rejections on the art, a brief review of Applicants' invention is appropriate. The invention relates to a method of forming an inductor and more particularly to toroidal inductors. A toroidal inductor has the advantage of substantially containing the magnetic field it produces within the core region, thereby limiting RF leakage that can cause interference with other components. When forming toroidal inductors, it can be advantageous to form a core region of the toroidal inductor of a material having a relative permeability value that is larger than one. In order to provide such a high permeability core region, conventional approaches have formed apertures in individual ceramic layers. After the aperture is formed in an unfired ceramic layer, high permeability material is inserted within the aperture. While providing acceptable results, the foregoing technique involves additional processing steps that are inconsistent with standard LTCC processing.

In contrast, the amended claims in the present application recite a process that avoids the need for the additional processing steps associated with the prior art. Rather than forming apertures and inserting magnetic material, the present method forms entire layers of the substrate from ceramic material having a high permeability. These layers can be selectively arranged to intersect a core region of the toroidal inductor. The foregoing process can provide improved manufacturing efficiency as compared to conventional processes that require backfilling.

II. Claim Rejections Under 35 USA §102(b)

Claim 1 has been rejected under 35 USC §102(b) as being anticipated by U.S. Patent No. 5,055,816 to Altman, et al ("Altman et al."). Altman et al. discloses a method of fabricating an electronic device by forming a double circular pattern of metallized holes in the carrier. However, Altman et al. makes no mention of any manufacturing steps that involve selectively varying a permeability of a portion of the carrier.

In response to Examiner's rejection, claim 1 has now been amended to emphasize the foregoing distinctions. Claim 1, as currently amended, recites a process for fabricating a ceramic substrate incorporating a toroidal inductor with relatively high permeability values at locations within a toroidal core region. These additional processing steps are not present in Altman et al. Accordingly, the Examiner's rejection of claim 1 has now been overcome.

Claims 1-4 and 6 have been rejected under §102(b) as being anticipated by U.S. Patent No. 5,479,695 to Grader, et al ("Grader et al."). Grader et al. teaches a method of forming an inductor within a ceramic substrate. However, the process in Grader et al. is entirely different as compared to Applicants' process recited in claims 1 and 4-6. For example, claim 1 recites forming in said ceramic substrate a first plurality of conductive vias radially spaced a first distance from a central axis so as to define an inner circumference. Claim 1 also recites "forming in said ceramic substrate a second plurality of conductive vias radially spaced a second distance about said central axis so as to define an outer circumference". Grader et al. does not show any such radial arrangement of vias. Instead, Grader et al. teaches preparing a substrate in which the vias are arranged in a linear pattern. For example a linear pattern of vias 307 are shown in Fig. 3 of Grader et al. Likewise, a linear pattern of vias 1421 is shown in Fig 14. Finally, a linear pattern of vias 1911 are also shown in Fig. 19. In contrast, Applicants' claim 1 recites that the vias are to be radially spaced around a central axis.

Grader et al. also fails to teach that "at least one of the ceramic layers has a permeability greater than one over an area that includes said entire substrate, and at least a portion of said first one of said ceramic layers is contained within a toroid shaped core region of said ceramic substrate, defined within said toroidal coil." Instead, Grader et al. teaches that apertures should be formed in individual layers and the apertures should be filled with higher permeability magnetic material. The process recited in claim 1 advantageously provides a high permeability material for the toroidal core while avoiding the additional processing steps taught by Grader et al. In view of the foregoing, Applicants respectfully request that the Examiner withdraw the rejection of claims 1-2, 4 and 6 under §102(b). Claim 3 has now been canceled. Accordingly, the rejection of claim 3 is now believed to be moot.

III. Claim Rejections Under 35 USC §103(a)

Claims 1 and 9-11 have been rejected under 35 USC §103(a) as being unpatentable over U.S. Patent No. 6,148,500 to Krone, et al ("Krone et al."). Krone discloses radially spaced vias around a central axis. However, Krone does not disclose a system for manufacturing a toroidal inductor in a ceramic substrate. Instead, Krone discloses a method for forming an

inductor in a board formed of epoxy/Eglass or epoxy/thermount laminated to copper foil sheets. See Krone et al., col. 3, lines 16-43. Holes are drilled in the laminated sheets and a toroidal ferromagnetic core is positioned within the core hole 22. The hole 22 is then filled with epoxy, prepreg, or Kevlar pulp. The foregoing distinction is important. One skilled in the art would recognize that the epoxy process disclosed in Krone would not be suitable for creating a toroidal inductor in a ceramic material. In particular, the toroidal ferromagnetic core in Krone would not be compatible with the ceramic firing process. This distinction has been emphasized in claim 1, which now recites that the ceramic substrate is formed by stacking a plurality of unfired ceramic layers.

Krone et al. also teaches away Applicants' method for reducing the processing steps required for producing a toroidal inductor that has a core permeability that is greater than one. Instead, Krone et al. requires additional processing steps that include drilling out a hole for the toroidal core, and backfilling the hole after a toroidal ferromagnetic core has been inserted. Applicants' invention avoids these additional processing steps. Applicants' method is advantageous in that LTCC structures can be constructed without altering conventional LTCC processing techniques. This is a significant departure from Krone and Grader, which require that high permeability materials be inserted or backfilled in apertures that are formed in the substrate during the manufacturing process. In view of the foregoing, Applicants' request that the Examiner withdraw the rejection of amended claim 1 and claims 9-11 under 35 USC §103(a) based on Krone et al.

Claims 5, 7 and 8 were rejected under §103(a) as being unpatentable over Grader et al. Claims 5, 7 and 8 have now been cancelled. Accordingly, this rejection is now believed to be moot.

IV. New Claims 35-37

Claim 35 combines the limitations of original claim 1 and dependent claim 9. Claim 35 is believed to be distinguishable over Krone et al. for the reasons stated above with regard to claim 1 and claims 9-11. Furthermore, none of the other cited references, either individually or in combination, teach Applicants' invention as stated in claim 35.

For example, Altman et al. does not teach or suggest a concentric toroid structure that includes a first toroidal inductor within a second toroidal inductor as recited in claim 35. Grader et al. does show some concentric structures but fails to show vias that are radially spaced around a central axis. Finally, there does not appear to be any suggestion or teaching in the

references that would motivate one skilled in the art to combine the references to achieve the claimed invention.

Claims 36-37 are similar to original claims 10-11 and should be allowed by virtue of their dependence on claim 35.

V. Conclusion

Applicants has made every effort to present claims which distinguish over the prior art, and it is believed that all claims are in condition for allowance. Nevertheless, Applicants invite the Examiner to call the undersigned if it is believed that a telephonic

interview would expedite the prosecution of the application to an allowance. In view of the foregoing remarks, Applicants respectfully request reconsideration and prompt allowance of the pending claims.

Respectfully submitted,

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